Figure 1: Sequential Flow of Events

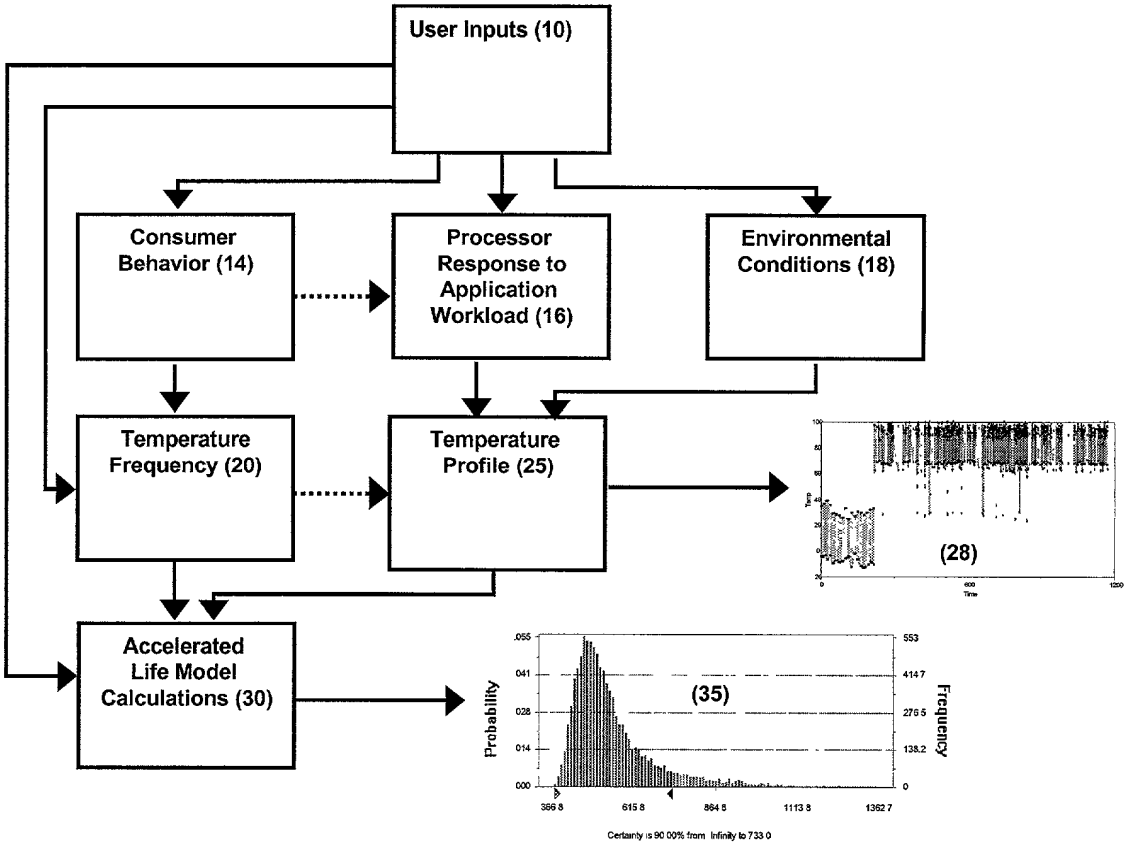


Figure 2: Depiction of Graphical User Interface for Design Inputs

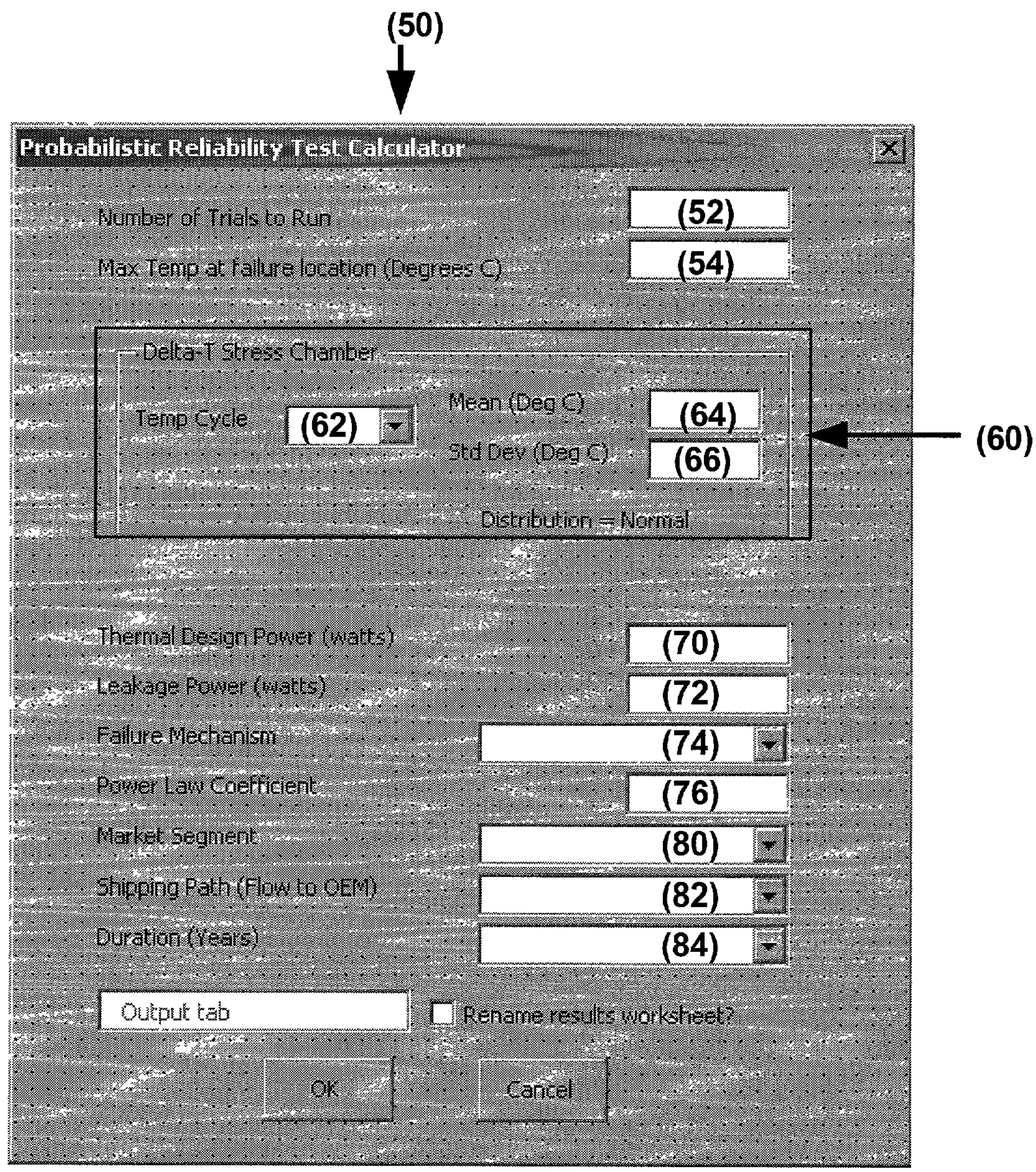


Figure 3: Representative Temperature Response

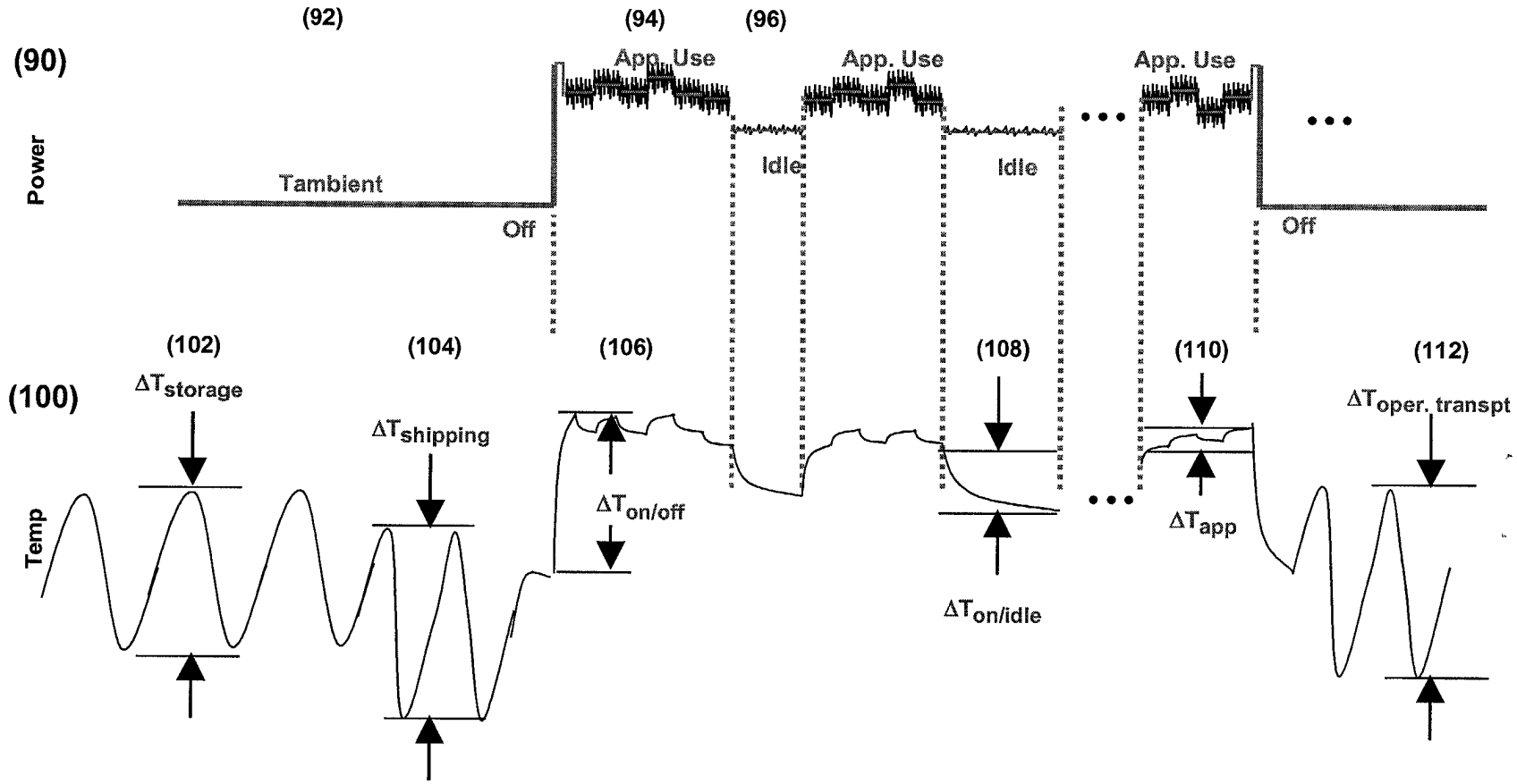


Figure 4: Modification to Coffin-Manson empirical Model

(205) (206) (207) (208)

$$N_{Accel\_Total} = N_{Accel\_Storage} + N_{Accel\_Shipping} + N_{Accel\_Operating}$$

$$N_{Use\_Stor.} \cdot \left(\frac{\Delta T_{Storage}}{\alpha_{Storage} \cdot \Delta T_{Accel}} \right)^n$$

(210)

$$N_{Ship,air} \cdot \left(\frac{\Delta T_{Ship,air}}{\alpha_{Ship,air} \cdot \Delta T_{Accel}} \right)^n + N_{Ship,grnd} \cdot \left(\frac{\Delta T_{Ship,grnd}}{\alpha_{Ship,grnd} \cdot \Delta T_{Accel}} \right)^n$$

(211) (212)

$$N_{Use\_On/Idle} \cdot \left(\frac{\Delta T_{Use\_On/Idle}}{\alpha_{On/Idle} \cdot \Delta T_{Accel}} \right)^n + N_{Use\_App} \cdot \left(\frac{\Delta T_{Use\_App}}{\alpha_{Use\_App} \cdot \Delta T_{Accel}} \right)^n + N_{Oper\_transport} \cdot \left(\frac{\Delta T_{Oper\_transport}}{\alpha_{Op.\_trans} \cdot \Delta T_{Accel}} \right)^n$$

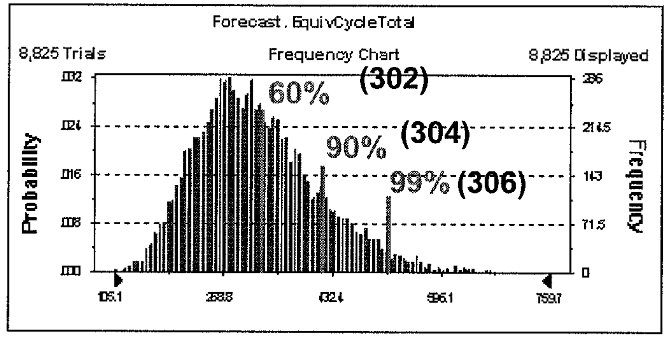
(213) (214) (215)

Figure 5: Input and output data from the Accelerated Life Testing algorithm

(300)

(320)

Temp Cycle Model Inputs	Value
# of simulation trials	8825
T Max at failure location (degrees C)	90.0 C
Temp Cycle	B
Mean(DT) Stress Chamber (degrees C)	190.0 C
Stdev(DT) Stress Chamber (degrees C)	2.00 C
Thermal Design Power (watts)	50
Leakage Power (watts)	5
Failure Mechanism	Solder Ball Fatigue
Power Law Coefficient	2.00
Failure Mechanism Zone	B
Market segment	CPU Mobile
Shipping lane (flow to OEM)	Standard
Duration (years)	7 years



(330)

(331) TEMP CYCLE STATS	(332) Cycles	(333) a(i)	(334) Min Temp	(335) Max Temp	(336) Delta Temp mean	(337) Delta Temp Stdev	(338) Equiv Stress Cycles (60%)	Equiv Stress Cycles (90%)	Equiv Stress Cycles (99%)	(339) Total damage Contribution
Storage	100	0.750	-40.00	60.00	20.00	3.00	30.0	50.0	70.0	9.1%
Shipping by ground	50	0.950	-40.00	60.00	20.00	3.00	40.0	60.0	80.0	12.1%
Shipping by air	50	0.800	-5.00	30.00	5.00	3.00	50.0	70.0	90.0	15.2%
Operating, use/idle	1,000	0.650	35.00	80.00	30.00	4.00	60.0	80.0	100.0	18.2%
Operating: application use	100,000	0.550	65.00	80.00	0.00	1.00	70.0	90.0	110.0	21.2%
Operator Transport	5,000	0.900	-20.00	60.00	20.00	3.00	80.0	100.0	120.0	24.2%
							330	450	570	

(340)

(341) POWER CYCLE STATS	(342) Cycles	(343) Min Temp	(344) Max Temp	(345) Delta Temp mean	(346) Delta Temp Stdev
Power on/off cycles	10,000	20.00	90.00	50.00	4.00

(310)

$$N_{storage}\cdot\left[\frac{\Delta T_{storage}}{\alpha_{storage}\cdot\Delta T_{stress}}\right]^{n} + N_{ship,air}\cdot\left[\frac{\Delta T_{ship,air}}{\alpha_{ship,air}\cdot\Delta T_{stress}}\right]^{n} + N_{ship,grnd}\cdot\left[\frac{\Delta T_{ship,grnd}}{\alpha_{ship,grnd}\cdot\Delta T_{stress}}\right]^{n} + N_{application\ use}\cdot\left[\frac{\Delta T_{application\ use}}{\alpha_{app\_use}\cdot\Delta T_{stress}}\right]^{n} + N_{on/idle}\cdot\left[\frac{\Delta T_{on/idle}}{\alpha_{on/idle}\cdot\Delta T_{stress}}\right]^{n} + N_{op.transport}\cdot\left[\frac{\Delta T_{op.transport}}{\alpha_{op.transport}\cdot\Delta T_{stress}}\right]^{n}$$

Figure 6: Illustration depicting how component location influences the size and magnitude of temperature fluctuations